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Reflection

Biodiversity and COVID-19: A report and a long road ahead to avoid another pandemic

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A report from a workshop organized by the Intergovernmental Platform on Biodiversity and Ecosystem Services on biodiversity and pandemics examined the scientific evidence on the origin of coronavirus disease 2019 (COVID-19) and other emerging zoonotic diseases. Here, we reflect upon the report's findings regarding how several important global initiatives are tackling the problems of preventing the emergence of zoonotic diseases by using the One Health approach.

Introduction

On March 11, 2020, after the emergence of SARS-CoV-2 in the city of Wuhan, China, the World Health Organization (WHO) declared the outbreak of coronavirus disease 2019 (COVID-19) a pandemic. Fifteen months later, more than 175 million people have been infected and 3.7 million have died from the disease according to the Johns Hopkins University COVID-19 tracker. The social and economic impacts of the pandemic are enormous—all sectors have been affected by travel and trade restrictions and lockdown measures—yet are far from being fully determined.

Such a major pandemic was foreseeable. The WHO had listed several potential infectious agents, including influenza viruses and coronaviruses, as potential candidates for “disease X”—a priority disease with epidemic potential for which there were no, or insufficient, medical countermeasures.¹ The “One Health” tripartite collaboration, gathering the World Organisation for Animal Health (OIE), the Food and Agriculture Organization of the United Nations (FAO), and the WHO, was established in 2008 to better improve the surveillance of zoonotic diseases at the interface of human, animal, and environmental health. The Global Early Warning System for Major Animal Diseases, Including Zoonosis (GLEWS)—which “embodies a unique

cross-sectoral and multidisciplinary collaborative tool in addressing health risks at the human-animal-ecosystems interface”—was expanded in 2013 to GLEWS+² with the aim of “systematically link[ing] to areas such as wildlife health, food and biological threats.” Important programs, endowed with considerable resources, have been put in place to predict, prevent, and prepare for such a disease outbreak. Finally, the Berlin Principles on One Health were released in 2019 during the “One Planet, One Health, One Future” conference as an “update” of the Manhattan Principles.³ However, the COVID-19 pandemic cruelly highlights the failure of predictions of emergence and preparedness strategies for pandemics.⁴

The experience of COVID-19 urges the need to understand the processes that led from the onset of emergence to the global health crisis.⁵ For this, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) launched a workshop, held virtually on July 27–31, 2020,⁶ to examine the scientific evidence on the origin of COVID-19 and other emerging zoonotic diseases and to provide options for controlling and preventing future pandemics. The workshop participants included 17 experts nominated by governments and organizations through an international call for nominations. Starting with the statement that 70% of

emerging diseases are zoonoses caused by microbes of animal origin, the IPBES workshop report explored the conditions that favor the spillover of these microbes at the interfaces between wildlife, livestock, and people.

Here, we reflect on how this report addresses the scientific evidence linking global changes (biodiversity loss, land-use changes, livestock expansion, and global trade) to the emergence and outbreaks of zoonotic diseases. We then discuss how several important global initiatives are tackling the problems of preventing the emergence of zoonotic diseases at the local level, i.e., the source of emergence, and at the global level, i.e., the source of global epidemics, by using the One Health approach. Finally, we present areas for future action to avoid failing again at pandemic prevention.

Biodiversity and pandemics *A large unknown diversity of potential emerging viruses*

The IPBES workshop report starts by stressing the unknown diversity of potential emerging diseases. An estimated 1.7 million undiscovered viruses are supposedly circulating in mammals and birds; among them, 631,000–827,000 could have the potential to infect humans. This estimated number must be compared with the total number of well-characterized viruses (including the viruses of

plants), which is only a little more than 10,000 according to the International Committee on Taxonomy of Viruses (<https://talk.ictvonline.org>). The report emphasizes that the most important reservoirs of pathogens with pandemic potential are mammals (bats, rodents, and primates) and birds (water birds), as well as livestock (pigs, camels, and poultry). Historically, the domestication of animals has been a major event in the acquisition of infectious diseases. Recent studies have confirmed the disproportionate role of primates, rodents, and domesticated animals in the sharing of DNA and RNA viruses, although bats appear important for the sharing of RNA viruses with other mammals, including humans.⁷

Land-use and livestock drivers of emerging zoonotic diseases

The IPBES workshop report lists the main factors that favor the emergence of zoonotic diseases. All these factors are linked to the overexploitation of natural resources and the environment. More than 30% of emerging disease events are most likely associated with land-use change, agricultural expansion, and urbanization. This statement finds support with the temporal analysis of global data showing that the increase in livestock is a major cause of both the decline in biodiversity and the increase in epidemics of zoonoses.⁸ In 1960, there were just under a billion cattle globally, but their number exceeded 1.6 billion in 2019; moreover, the number of pigs worldwide has grown from 500 million to 1.6 billion, and the number of chickens has increased from 5 to 30 billion. Today, livestock have a biomass greater than that of all human beings. The number of poultry is practically of the same order of magnitude as the number of wild birds, which has been recently estimated at around 50 billion.⁹ The total number of wild birds was estimated to be between 200 and 400 billion in 1997, reminding us of the dramatic decline in wildlife in recent decades. The growing importance of livestock and its ecological footprint on the planet threatens biodiversity and increasingly puts human and animal health at risk.

Biodiversity loss

The IPBES workshop report stresses the role of biodiversity in emerging zoonotic diseases. This is particularly relevant in the context of the current biodiversity crisis, underlined by the

IPBES, which estimated that approximately 25% of species are already threatened with extinction. The Living Planet Index (<https://www.livingplanetindex.org>), based on long-term surveys of more than 4,000 species of vertebrates, shows that increasing deforestation and agricultural expansion were the key drivers of almost 70% of the decline in the tracked vertebrate populations between 1970 and 2016. A quarter of global forest loss is due to the conversion of forest to commodities (beef, soy, palm oil, and timber). The IPBES workshop report recalls that deforestation and land conversion to commercial plantations have dramatic consequences on both biodiversity and emerging infectious diseases. The increases in outbreaks of zoonotic and vector-borne diseases from 1990 to 2016 were found to be associated with deforestation, mostly in tropical countries, and with the increase in areas of oil palm plantations.¹⁰

Climate change

Climate change was also listed by the IPBES workshop report as an important key factor enhancing disease emergence or modifying geographical distributions of reservoirs and vectors. Studies confirmed that zoonotic diseases and vector-borne diseases are highly climate sensitive as a result of the involvement of various reservoirs and vectors.¹¹ For example, the epidemiology of Lyme disease, a tick-borne and zoonotic disease due to *Borrelia burgdorferi*, is influenced by a large number of climate factors, including precipitation, temperature, climate change, and climate variability. In Asia, the increasing incidence of scrub typhus, another vector-borne and zoonotic disease, has been associated with the increase in temperature.

Wildlife trade, farming, and consumption

The IPBES workshop report puts its main emphasis on the trade and consumption of wildlife given that about 24% of all wild terrestrial vertebrate species are traded globally. International legal wildlife trade was estimated to be around US\$107 billion in 2019, whereas the illegal wildlife trade was estimated to be worth US\$7–\$23 billion annually. A recent study estimated that around 421,000,000 threatened wild animals were traded between 226 nations or territories between 1998 and 2018.¹² Wildlife farming has

also greatly expanded in the last few decades. The IPBES workshop report concludes that farming, trade, and consumption of wildlife and wildlife-derived products (food, medicine, and fur) contribute to both biodiversity loss and emerging diseases, including SARS and COVID-19. The selling of wildlife in wet markets is a critical health issue and has been implicated in zoonotic outbreaks, including SARS and COVID-19.¹³ The culling of 15 million mink in Denmark in 2020 reminds us of the role of wildlife farming in the transmission of zoonotic diseases, including COVID-19. Conservation biologists have also warned of the threat that COVID-19 poses for endangered species.

Actions needed

The IPBES workshop report stresses the need to promote responsible consumption, such as reducing excessive consumption of meat from livestock and poultry production and reducing unsustainable consumption of commodities, such as palm oil or exotic wood, from emerging disease hotspots. The report also calls for the implementation of the One Health approach in national governments in order to improve disease surveillance and control across human health, animal health, and environmental sectors.

The report identifies several actions. The first concerns predicting geographic origins of future pandemics by identifying key reservoir hosts and likely microbes to emerge in relation to environmental and socioeconomic changes. The second calls for a transformative change to reduce the consumption, globalized agricultural expansion, and trade that have led to pandemics by using taxes or other mechanisms on meat demand and consumption. The third action asks to implement policies to reduce pandemic emergence related to the wildlife trade by building better collaborations among international organizations. Lastly, the IPBES workshop report acknowledges the importance of valuing Indigenous peoples and local communities for their engagement and knowledge in pandemic-prevention programs.

Lessons learned and research needs

New global initiatives

Most of the recommendations that emerged from the IPBES workshop

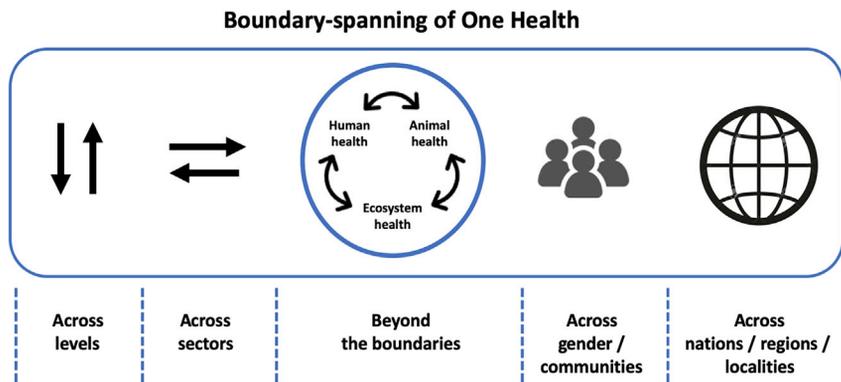


Figure 1. Boundary spanning helps us to think about a new way for the One Health approach to tackle the risk of emerging zoonotic diseases at the interface between humans, animals, and the environment

The concept of boundary spanning is a tool for exploring, accessing, and obtaining knowledge outside of local processes by using system thinking to be more informed, adaptable, and flexible. The use of boundary spanning in One Health fosters interconnections across levels of organizations, sectors, academic disciplines, communities, gender, and nations in order to tackle complex issues of emerging zoonotic diseases at the boundary of human health, animal health, and ecosystem health.

report, and from other reports, have been taken into account by recent global initiatives.

In June 2021, the One Health WHO-OIE-FAO tripartite and the United Nations Environment Programme (UNEP) jointly launched the One Health High Level Expert Panel.¹⁴ The 26 appointed experts serving as members of the OHHLEP will help the One Health tripartite plus UNEP to provide “policy relevant scientific assessment on the emergence of health crises arising from the human-animal-ecosystem interface” and “guidance on development of a long-term strategic approach to reducing the risk of zoonotic pandemics, with an associated monitoring and early warning framework, and the synergies needed to institutionalize and implement the One Health approach, including in areas that drive pandemic risk.” The Subsidiary Body on Scientific, Technical and Technological Advice¹⁵ recommended that the 15th Conference of the Parties of the Convention on Biological Diversity (CBD), to be held in Kunming at the end of 2021, adopt a decision

recognizing that the COVID-19 pandemic has further highlighted the importance of the relationship between people and nature and highlights the urgency of addressing the biodiversity crisis alongside the climate crisis, the need for transformative change as part of the “build back better” agenda,

and the recognition of a biodiversity-inclusive One Health approach that would support preventing and reducing the risk of future zoonotic pandemics

and requests that the executive secretary “facilitate, as appropriate, the implementation of the global action plan for biodiversity and health” and

continue collaboration with the World Health Organization, the World Organisation for Animal Health, the Food and Agriculture Organization of the United Nations and the United Nations Environment Programme, including, as appropriate, the One Health High-level Expert Council, to promote a biodiversity-inclusive One Health approach.

A new international initiative called Preventing Zoonotic Disease Emergence (PREZODE) was launched at the One Planet Summit for Biodiversity, organized on January 11, 2021. The PREZODE program (<https://prezode.org/>) aims to bring together international research teams to prevent the risk of the emergence of zoonoses at the interface between environment, wildlife, and livestock.

Boundary spanning for science and policy dialogue

To prevent the emergence and spread of zoonotic diseases, it is crucial to develop

boundary spanning in relation to human and animal health, the environment, and the economic model. Boundary spanning presupposes system thinking in order to be less dependent on particular settings and more knowledgeable, adaptable, and flexible. The concept of boundary spanning is a tool for exploring, accessing, and obtaining knowledge outside local processes¹⁶ and fostering interconnections between organizations, institutions, or disciplines in order to tackle complex issues. Boundary spanning gives the opportunity to consider a new way to conduct research, notably research on emerging zoonotic diseases at the interface between humans, animals, and the environment. Boundary spanning facilitates new integrative research in support of the One Health approach and opens it at the interface of disciplines, as well as political sectors (Figure 1).

Adaptive law and policies

In order to respond in an appropriate manner to the environmental emergency, we need adaptive law embedded in a framework able to integrate new environmental and health objective knowledge in order to produce evidence-based measures or policies adapted to the situation in a specific socio-ecosystem. This implies that national laws should have the same properties as those promoted by the One Health approach and contain in their drafting the possibility of a cursor that can move with advances in science. Environmental law needs to be reconsidered around the notion of science-based knowledge relying on the One Health approach.

For example, the increase in epidemics due to land change and deforestation is acknowledged in the joint report of the CBD secretariat and the WHO. Scientists, public-health practitioners, and policy-makers should reconcile the need to preserve biodiversity with accounting for the health risks. One way would be the implementation of an international governance of forests and their contributions to a healthy planet and people together with the development of research on disease-regulating services provided by forests and other ecosystems. In turn, a revision of the definition of “forest” by the FAO to avoid afforestation, forest expansion, and agricultural conversion of grasslands could also help to better manage forested

and planted areas.¹⁰ The identification of sectors contributing to the national law and governance of forests is pivotal for coherent and common action.

Although the notion of adaptive law might be criticized in the name of the security and stability of a legal system, the COVID-19 pandemic has led to major adaptation of significant parts of the law in various sectors in different countries.^{17,18} For the sake of public health, the feasibility of such an adaptation should be carefully scrutinized to be fully integrated into a new framework for adaptive environmental law.

Conclusion

The IPBES workshop report has explored the conditions favoring the emergence of zoonotic diseases and has proposed several recommendations, most of which have been taken into account by recent global initiatives, such as the launching of OHHLEP. The main remaining question is how to avoid future failure in preventing new emerging infectious diseases and pandemics.

New global initiatives give the opportunity to consider the socio-ecosystems and the interactions between the socio-cultural practices and animal and human health, as well as environmental health. The dialogue between science and policymakers will be crucial, but it requires transformation of political commitment into concrete involvement. Moving from strategy to strategy, while knowing at the time of their implementation at the national level that they will fail because of the delay between the international commitment and its national translation, is no longer an option. We should step back, change the rules, and start to act simultaneously, internationally, and locally in a genuine way and not only check boxes

on lists that report advancement toward the objectives.

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